Diagnosing Plant Problems - An Analytical Approach

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This article is the second of a five-part series of articles on diagnosing plant problems. The goal of these articles is to provide you with some guidelines for determining the causes of plant problems. This information will mainly apply to landscape plants, but it should also be useful for indoor plants. Some of the information in this series of articles has been adapted from extension publications written by Oregon State and Washington State Universities. In this first article, two categories of plant stress were discussed. In this article, causes of plant problems and the five steps involved in the diagnostic process will be covered. In the next article, some characteristics of diseases and insects will be discussed. Plant problems due to construction damage, environmental extremes, nutrient deficiencies and chemical toxicities will also be covered in later articles.

Causes of Plant Problems

Many factors can cause problems for plants, including weather, diseases, soils, or management decisions. The question is, can these factors be placed into certain categories that will make plant diagnosis easier. The folks at Oregon State University have placed the factors or causal agents into five categories that to make diagnosing plant problems straightforward (more or less). The five categories are:

1. Insects or mites - sucking, chewing, or rasping problems.
2. Pathogens - diseases: fungi, bacteria, and viruses.
3. Chemicals - herbicides, insecticides, fungicides, growth regulators, and air pollution.
4. Environment - includes weather and related natural events.
5. Management - includes fertilizing, watering, soil (and manipulating it), handling the plant before and after planting, and other cultural practices.

Placing these factors or causal agents into five categories may seem a little limiting, but the categories are very useful when making a diagnosis. Each category can cause distinct symptoms or signs on a plant, but many of the factors may also share symptoms between categories. Therefore, try to gather as much information before jumping to conclusions. For instance, I was once asked to examine a number of young trees that were dying at a landscape site. When I arrived and inspected several trees, I found a few gopher holes around two or three of the trees that were just about dead. I at first thought that animal damage was causing the problem, yet a number of the other trees at the site were growing poorly, so perhaps the gopher damage could only explain why several trees were dying. Upon inspecting many other trees at the site, gopher holes were absent around them, but they did have pruning wounds that were infected with cytospora canker. Apparently several trees were infected with this disease, so the maintenance crew at the site pruned the diseased trees and then went on to prune healthy trees with sanitizing the tools before moving on to the next tree. As you can imagine, the cultural practice caused the problem to spread. The point is, if I had stopped after examining only several trees that were growing poorly, I would have missed making the correct diagnosis.

The Analytical Approach for Making the Correct Diagnosis

Making the correct diagnosis for a plant problem can seem like a daunting task, particularly as diagnosticians ask themselves where to start. Presented below are the five steps to making a plant diagnosis. These steps should be followed more or less in order to help keep you on track during the diagnostic process. In each step, I present a basic guideline to follow. With your current and future experiences, you can add information to each step to make the diagnostic process more complete.

FIRST STEP: Define the problem.

Important parts of this step include:

a. Identify the plant species and determine if the growth is normal.
b. Keep plant cultivar differences in mind.
c. Compare plant growth to the time of year that the problem started.

As you complete this first step, determine if the plant really has a problem. Examine the entire plant carefully and examine the community of plants in the area if applicable. Try to determine where the plant damage started.

SECOND STEP: Look for a pattern (if the growth is abnormal).

Important parts of this step include:

a. Examine the community of plants (when applicable) to help you determine if a pattern is present.

b. Certain patterns can implicate certain causal agents or factors.
    i. random patches: random plants at the site are damaged. Look for soil problems or living factors (insects or diseases).
    ii. pattern present: a pattern of damaged plants can be seen at the site. Look for nonliving factors such as chemical, environment, or management.
    iii. uniformly effected: plants that are uniformly effected may have been damaged by the environment or management practices.

c. How many species are involved? Determine if two or more species of plants are effected.
    i. two or more plant species are effected in a mixed planting: the causal agent or factor may be chemical, environment, or management.
    ii. only one species is effected: chance are a disease or insect is causing the problem.

d. When looking for a pattern if a plant disease is the causal agent, its characteristics are:
    i. only one species or genus is effected.
    ii. only one plant in a group may be effected (random pattern).
    iii. symptoms are similar from plant to plant.
    iv. diseased plants normally do not become infected and die overnight.

This second step, looking for a pattern, depends on examining a community of plants. Procedures to follow include: check the number of effected species, look at the edges or sides of a plant or landscape bed, look for stripes in the field, lawn, or individual plants. Finding a pattern should help when diagnosing a plant problem.

THIRD STEP: Examine the plant(s) and determine which parts are effected. Determine how the damage or problem has developed or progressed.

Important parts of this step include:

a. Roots: Examine the plant's roots. Any of the five categories can cause root damage. Pay attention to soil-borne insects or diseases and check for soil-related management problems.

b. Stems: Examine the plant's stems. Any of the five categories can cause shoot damage.
   i. growth rate over the last several years should be examined on stems.
   ii. pay particular attention to pests (diseases or insects), environment, or management.

d. Leaves: Examine the plant's leaves. Leaves can be effected by any of the five categories. When examining an entire plant, determine which leaves are effected:

   i. top or bottom
   ii. new or old
   iii. interior or exterior
   iv. direction they face
   v. leaf size: large or small

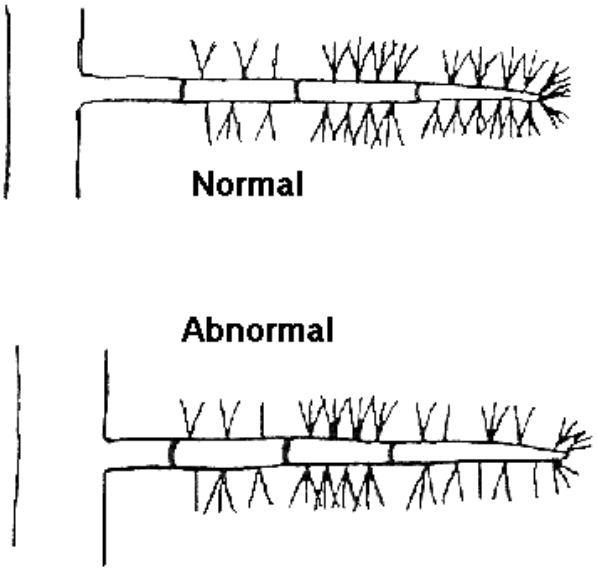

Figure 1. Pine needles as they would appear on a plant with normal (top) or abnormal (bottom) growth. Compare the number of needles on the new growth for both branches.

In Figure 1, we can see that the new growth on both pine branches differs. The branch with abnormal growth has fewer needles on the new growth compared to the branch with normal growth. An evergreen conifer that loses needles on new growth often has a problem.

In Figure 2, we see plants that have lost the entire canopy or a major portion of the canopy (section A) and plants that have lost single branches in various parts of the canopy (section B). If an entire canopy or major portions of a tree or shrub die (section A), then a root problem may be causing plant death. If the entire canopy or major part dies gradually, then a disease, such as Armillaria root rot or Verticillium wilt, or a root weevil may be the cause. If only single branches that are scattered on the canopy are dying (section B), then the problem is probably related to the foliage or aerial environment. Sudden death of scattered branches may be related to a chemical, animal or weather damage, whereas a slow decline in scattered branches may be related to disease (e.g., canker) or an insect (e.g., borer).

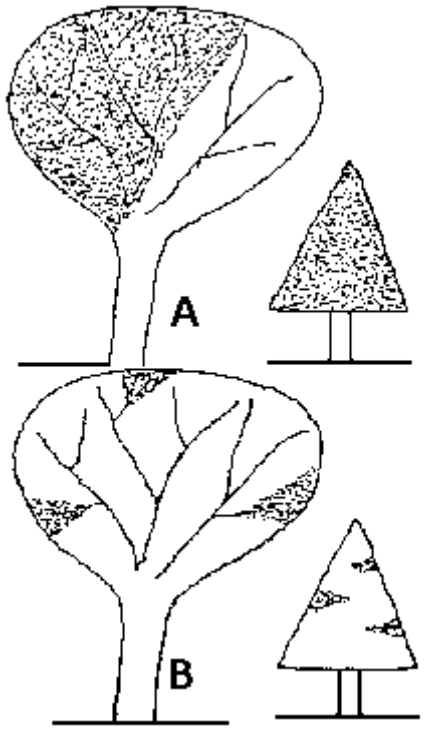

Figure 2. Parts of plant canopies that are damaged. In section A, a major portion or the entire canopy is effected. In section B, scattered branches are damaged or killed. Try to determine if the damage or death was gradual or sudden if most of the top dies or just scattered branches die.

FOURTH STEP: Determine what signs and symptoms are visible and distinguish between living and nonliving factors.

Important parts of this step include:

a. Closely examine the entire plant or plant part(s) to look for symptoms and signs.
   i. symptom: modified appearance of the plant part. Look for abnormal appearance.
   ii. sign: presence of an organism or direct evidence of it. Look for molten insect exoskeletons, insect egg masses, insect frass, fungal mycelium, spores, etc.

b. Look at the plant or plant parts to determine if insect or disease indicators are present. Are leaves chlorotic or curled, or do stems have sunken areas? Are plant parts missing entirely?

c. Leaf problems may include:
   i. yellow leaves: the cause may be soil problems, insects or diseases.
   ii. irregular pattern on leaves: the cause may be chemicals or diseases.
   iii. leaves with spots - uniformly injured or killed: the cause may be chemicals, management, or the environment.
   iv. leaves and stems curl: the cause may be insects, chemicals or mechanical injury (management problem).
   v. galls (knots) on leaves, stems, or trunks: the type of gall indicates the type of pest causing the knotty growth.
      a. solid gall: indicates that a disease caused the abnormal growth.
      b. hollow gall (or holes in the gall): indicated that an insect caused the knotty growth.
   vi. missing plant parts (e.g., bark or branches): the cause may be animals, insects, or management problems.
   vii. wilting: can be caused by any of the problem categories. For instance, insects or diseases that attack the root system or the vascular system in the stems or trunks can cause wilting. Extreme environmental conditions or poor management can also cause wilting. Check for root problems early in the diagnostic process and then check the stems or trunks for various problems.

d. Leaves with spots: plant pathogens (disease causing organisms) can cause leaf spots that are usually characteristic of their presence. A positive identification is necessary if a person wants to apply a pesticide legally. For instance, when making a diagnosis, you will need to know whether you are dealing with a particular species of fungus or bacteria so that the proper fungicide or bacteriocide can be applied. In the next article of this series, several distinctive characteristics of bacterial, fungal, and viral attacks on plants will be discussed and illustrated.

e. Insects can also cause distinguishing symptoms on plants and leave telltale signs too. Symptoms of insect damage will also be briefly described in the next part of this series.

FIFTH STEP: Synthesis information and ask plenty of questions - a key to success!

Important parts of this step include:

a. Among the first questions to ask are:

i. past and present management practices: what was done for plant maintenance over the last few years or months? Having a logbook of landscape maintenance practices would be helpful here.
ii. what is the recent history of the area of the where the plant or plants are located?
iii. what was the recent weather in the area? Any frosts, hail, deep freezes during winter?
iv. were any pesticide treatments applied in the recent past?

b. Examine the soil and find out its specific characteristics for pH, nutritional status (amounts of minerals in it), amounts of salts, and drainage. With regard to drainage, was any site construction completed that could have changed above or below ground drainage?

c. Determine how the plant was handled before it was purchased or installed.
i. what kind of root system did the plant have? Was the plant balled and burlapped, in a container, or dug from the wild as a bare root plant?
ii. what was the handling procedure for the plant? Was the plant dug and sold in the middle of summer? Was the root ball broken due to careless (or belligerent) handling before planting? Unfortunately, I have seen landscape workers throwing balled and burlapped stock out of a truck just before planting them.

d. Ask questions during the <u>entire</u> diagnostic process.

When you think about it, questions should be asked during the entire diagnostic process, starting with identifying the plant and its problem(s). Getting answers to questions will enable you to combine the information and make the correct diagnosis. Ask other experts for their opinions when help is needed. County extension faculty and horticulture professionals make good resources when trying to determine causes of plant problems.

I am convinced that plant diagnoses are very difficult to make because we either fail to ask enough questions, fail to ask the right questions, or lack answers to important questions that will help us to complete the diagnosis. If your remember in the first article, I described the situation with a customer bringing in a four-inch long maple branch with one dead leaf hanging on it, and the customer wanted to know what was wrong. When you ask important information, such as the condition of other plants in the area, the soil pH, or fertilization practices over the last year, the customer may not know answers to these questions for one reason or another. Without asking many questions and getting answers to the ones you do ask, making the correct diagnosis will be very difficult.

Complications of Diagnosing Plant Problems

Diagnosing plant problems correctly can still be difficult even if the five diagnostic steps were followed. Making a diagnosis can be challenging for several reasons. First, symptoms can be confusing. When you see a symptom or sign, you may be unsure of exactly what you are looking at or what is abnormal. Second, some disorders or causal agents cause similar symptoms. For instance, some symptoms of drought stress and flood stress are similar on many plants. Finally, two disorders expressed together may cause symptoms that are atypical for either problem. For these reasons, the diagnostician must collect as much information as possible by asking questions. Experience is also very helpful, particularly when diagnosing plants with

atypical symptoms. Again, asking experienced people for help should assist you with making the correct diagnosis.

Diagnosing plant problems can be made easier by using a systematic approach. In this article, we have categorized problems into five areas, and a five-step analytical procedure has been briefly described. The information presented here may not instantly make you an expert at diagnosing plant problems, but it will provide you with the tools to get to a correct diagnosis. In the next article of this series, we will cover some distinguishing characteristics of diseases and insects.